also increased significantly with an increase in the 3 potassium levels: 0.168, 0.428, and 0.688, respectively.

Among plants receiving a relatively low amount of inoculum, rates of reproduction were apparently limited by the amount of potassium available, as indicated by the highly significant differences between treatments. On the other hand, with higher amounts of nematode inoculum an increase in potassium correspondingly increased the rate of reproduction up to a certain point between that produced by the medium and high levels of potassium. Thus it seems that rates of reproduction of nematodes among plants receiving medium and high levels of potassium are correlated with the amount of root available and with competition between nematodes for living space in the roots rather than the amount of potassium available.

SUMMARY

Lima-bean plants grown in sand cultures were inoculated with the root-knot nematode *Meloidogyne incognita*. Three nutrient treatments were employed supplying low, intermediate and high potassium concentrations. Two levels of nematode inoculum were used at rates of 50 and 200 egg masses.

Results of this experiment are:

1. Differences in the number of female nematodes produced on the roots and differences in the rate of their oviposition can be induced by variations in potassium concentrations.

2. Among plants receiving a relatively low amount of inoculum, rates of nematode reproduction were apparently limited by the amount of potassium available.

3. In plants receiving relatively higher inoculum and treated with higher potassium concentrations, rates of reproduction are correlated with the amount of root available and with competition between nematodes for root space rather than with the amount of potassium available.

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ZOOLOGY.—*The last copepodid instar of* Diaptomus sanguineus *Forbes* (*Copepoda*).

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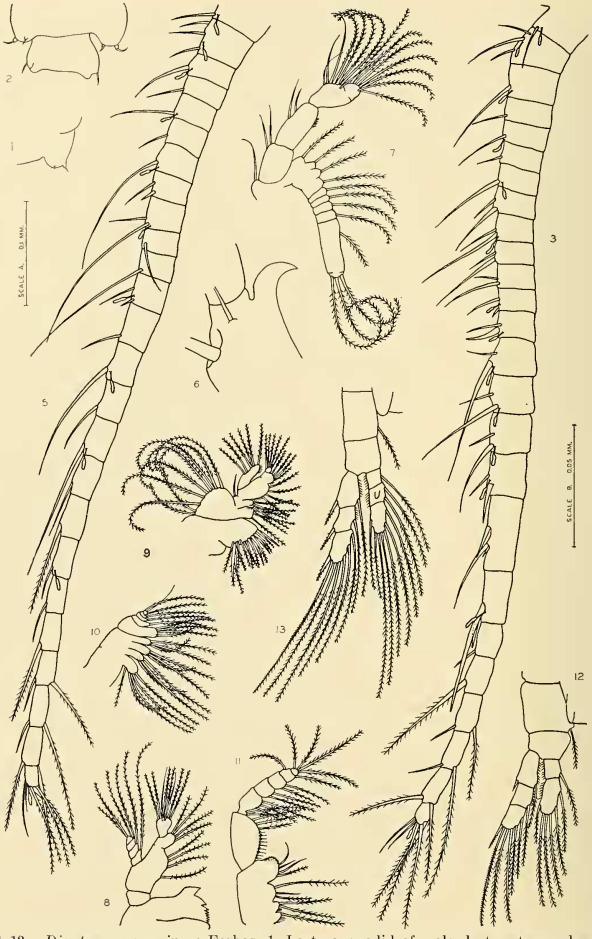
The larval stages of *Diaptomus vulgaris* Schmeil have been described by Grandori (1912) and those of *D. castor* (Jurine) by Dietrich (1915) and Gurney (1931). Nauplii and copepodids of North American diaptomids, however, are almost entirely unknown. Ewers (1930) described the nauplius stages of *D. siciloides* Lilljeborg. C. B. Wilson (1932) described briefly the fifth leg of "young" male and female *D. leptopus* Forbes and the fifth leg of "undeveloped" male and female *D. oregonensis* Lilljeborg, both of these immature forms being apparently the last copepodid stage.

It is the purpose of this paper to describe the last copepodid instar of *D. sanguineus* Forbes and in so doing to supply certain details of the structure of the adult that were not mentioned in Forbes' descriptions (1876, 1882) or by later authors. Since large numbers of the last copepodid stage of both sexes may occur in plankton, along with adults of this and often other species, it is desirable to be able to correlate this immature stage with its adult form.

The specimens of *D. sanguineus* upon which the following description is based were collected from a small ice-covered pond in Weston, Mass., in February and March of 1950 and 1951. The copepods were studied entire and dissected, as stained mounts in balsam, as unstained mounts in glycerin, or



FIGS. 1–13.—*Diaptomus sanguineus* Forbes: 1, Last copepodid of male, last metasomal somite, one side only; 2, adult male, last metasomal somite and genital segment; 3, last copepodid of male, right antennule; 4, adult male, right antennule; 5, last copepodid of male, left antennule; 6, adult male, process on segment 23 of right antennule; 7, last copepodid of male, antenna; 8, same, mandible; 9, same, first maxilla; 10, same, second maxilla; 11, same, maxilliped; 12, same, first swimming leg; 13, same, second swimming leg. (All figures drawn with the aid of a camera lucida. Scale A applies to Fig. 1 only, scale B to Figs. 6, 18, and 19, and scale C to the remaining figures.)

as unstained mounts in water. The last method was most satisfactory for distinguishing the aesthetes and other minute details. Only salient points of difference between the larval and adult stages are described, since many features are better shown by figures. Specimens of both sexes of copepodids and adults have been deposited in the United States National Museum.

Last copepodid, male.—The body proportions are similar to those of the adult. The average total length and average sizes of the body regions, based upon 10 copepodid and adult males, measured without pressure, are indicated in Table 1. The metasome reaches its greatest width at the level of the second somite. The posterior lateral areas of the last somite bear a pair of sensory spines, smaller in the copepodid (Fig. 1) than in the adult male (Fig. 2). The urosome consists of four somites, as compared to five in the adult male.

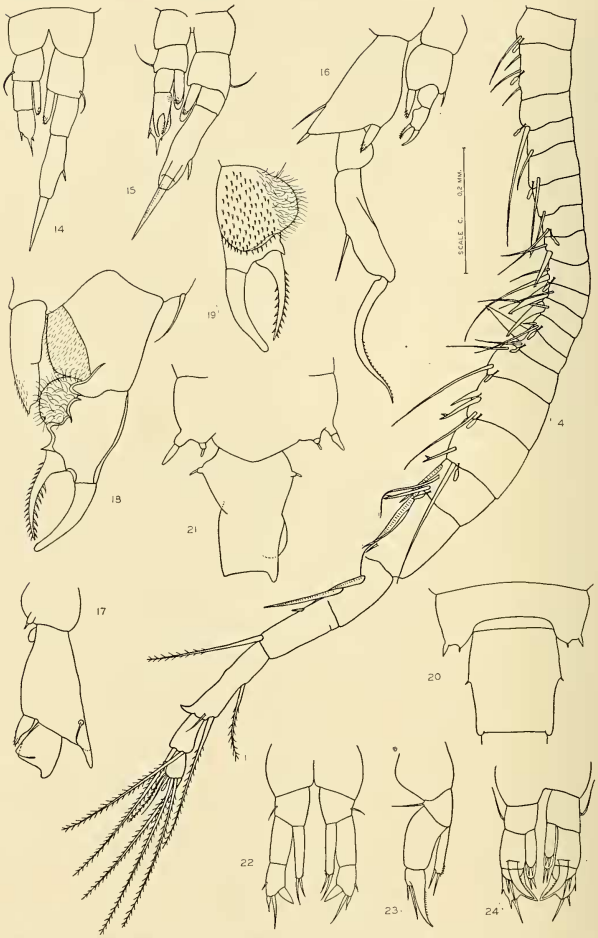
The right antennule (Fig. 3) is slenderer than that of the adult male (Fig. 4), 25-segmented, and nonprehensile. It differs from that of the left side (Fig. 5) in the presence of incipient spines and depressed processes on segments 13 and 17–19. The major spines of 8 and 10–11 are represented in the copepodid by stout setae. The right antennule of the adult is distinguished by the enlargement of the usual minor spine of segment 8, and the presence of a very stout spinous cuticular process on 15. The process of segment 23 is as shown in Fig. 6.

The antenna of the copepodid (Fig. 7) resembles that of the adult, except that in the latter the joints are somewhat more distinct and there are nine instead of eight setae on the inner side of the last endopodite podomere. The mandible of the copepodid (Fig. 8) is similar to that of the adult, except that in the palp of the latter there are nine instead of eight setae on the last endopodite podomere, and the very reduced fifth podomere of the exopodite is hardly separated. No important structural differences between the copepodid and adult were observed in the first maxilla (Fig. 9), second maxilla (Fig. 10), or maxilliped (Fig. 11). The first (Fig. 12), second (Fig. 13), third, and fourth swimming legs are similar in both instars, although the joints in the copepodid legs are less distinct. The cuticular lobe on the second podomere of the endopodite of the second leg occurs in both instars.

The right fifth leg has a single terminal spine (Fig. 14), and the left three apical spinous processes. In specimens about to molt the form of the adult leg may be seen within the copepodid form (Fig. 15). The adult leg (Fig. 16) is distinguished by the broadened second basipodite segments, that of the right side having a small, inner, proximal lamella and a distinctive elongation of the distal outer corner (Fig. 17). The apical podomere of the left exopodite has prominent chitinized areas on the anterior side (Fig. 18), that at the base of the proximal process emphasizes the extended, pointed portion of the segmental body which is of systematic importance. The pads are well developed, the proximal being medially placed and bulging, the distal confined largely to the posterior face (Fig. 19).

Table 1.—Measurements (in Microns) of Last Copepodid and Adult Instars of Diaptomus sanguineus, Each Figure Representing the Average of 10 Specimens

Body region	Copepodid male	Adult male	Copepodid female	Adult female
Total length	1367 (1287–1430)	1591 (1515–1701)	1522 (1500–1558)	1730 (1689–1773)
Head	336 × 323	361 × 342	353 × 356	391 × 387
First thoracic	130 × 323	143 × 347	145 × 351	157 × 406
Second thoracic	136 × 336	163 × 359	158 × 372	181 × 422
Third thoracic	105 × 326	123 × 352	121 × 364	140 × 409
Fourth thoracic	98 × 296	115 × 325	120 × 333	132 × 380
Fifth thoracic	87 × 257	102 × 285	107 × 289	128 × 347
Sixth thoracic	64 × 196	71 × 226	79 × 240	121 × 302
First abdominal	67 × 125	82 × 134	162 × 145	201 × 169
Second abdominal	84 × 105	104 × 100		
Third abdominal	73 × 98	96 × 93	81 × 110	65 × 98
Fourth abdominal	100 × 100	89 × 90	108 × 113	77 × 117
Fifth abdominal		64 × 98		
Caudal ramus	105 × 48	110 × 46	103 × 54	107 × 55



FIGS. 14–24.—*Diaptomus sanguineus* Forbes: 14, Last copepodid of male, fifth pair of legs; 15, same, fifth pair of legs about to molt; 16, adult male, fifth pair of legs; 17, same, basal segments of leg 5, turned somewhat mediad to show lamella of second basal segment in profile; 18, same, left fifth leg, anterior view; 19, same, left fifth leg, distal portion of exopodite, posterior view; 20, last copepodid of female, last metasomal somite and genital segment; 21, adult female, last metasomal somite and genital segment; 22, last copepodid of female, fifth pair of legs; 23, adult female, fifth leg; 24, last copepodid of female, fifth pair of legs about to molt.

Last copepodid, female.—The outline of the body is similar to that of the male. The average measurements for both copepodid and adult females, corresponding to those given for the male, are indicated in Table 1. The pair of sensilla on each side of the last metasomal somite (Fig. 20) are smaller than the prominent ones of the adult (Fig. 21) which are highly characteristic of *D. sanguineus*. The urosome in both instars consists of three somites. The genital segment of the copepodid (Fig. 20) is simple, but that of the adult is elongate and asymmetrical (Fig. 21).

The right and left antennules are similar in both instars, resembling the nonprehensile appendages of the males. The species is of the "little setaceous" type, having only one seta on segments 11 and 13–19. The antennae and mandibles differ in the two instars in the same way as in the male. The first and second maxillae, maxillipeds, and first through fourth legs are similar to those of the male.

The fifth leg in the copepodid (Fig. 22) differs from the adult in the presence of the lateral seta of the second exopodite podomere. The prominent claw of the adult (Fig. 23) is weakly developed. In specimens about to molt the form of the adult female may be seen within (Fig. 24).

The principal points of difference between the last copepodid and the adult stages, aside from changes in body size and proportions, are found in both sexes in the development of the sensilla of the last metasomal somite, in the number of terminal setae on the endopodites of the antennae and the mandibles, and in the form of the fifth legs. The male is further distinguished by the number of somites in the urosome, and by the structure of the right antennule. The female differs conspicuously in the development of the genital segment.

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BOTANY.—*A study of the roots of Pinus virginiana in relation to certain Hymenomycetes suspected of being mycorrhizal.* Edward Hacskaylo, George Washington University. (Communicated by William W. Diehl.)

The occurrence of ectotrophic mycorrhizae on *Pinus virginiana* Mill., a common conifer of the eastern United States, has been referred to by Henry (1), Kelley (2), McComb (4), and McDougall (5), but no mention was made concerning the identity of the fungi involved in the relationship with this tree species. Inasmuch as fungal cultures could be obtained from sporophores collected from a stand of pine, it would be possible to determine experimentally the identity of some of those species associated in the mycorrhizae of *P. virginiana*. This could be accomplished by subjecting seedlings germinated under aseptic conditions to simple inoculation tests using pure cultures of each fungus suspected because of its constant association with the pine stands.

Sporophores of several Hymenomycetes were collected during the summer and fall of 1949 from two nearly pure stands of *Pinus virginiana* occurring in Virginia near Washington, D. C. The following fungi were identified: *Amanita verna* (Bull.) Quel., *Boletus americanus* Pk., *Boletus* sp., *Clavaria pulchra* Pk., *Lactarius chrysorrheus* Fr., *L. piperatus* (Scop.) Fr., *Tricholoma equestre* (L.) Quel., and *T. portentosum* Fr. From young sporophores of the above, tissue fragment cultures were obtained on a 50–50 mixture of commercial potato dextrose and malt dextrose agars.